Travel Model Two Development: Calibration and Validation Work Plan

Technical Paper

Metropolitan Transportation Commission with Parsons Brinckerhoff, Inc.

April 9, 2014

m:\development\travel model two\demand\deliverables\calbration approach\2014 04 09 release calibration & validation workplan.docx

Table of Contents

1 Introduction

MTC is rebuilding the representation of demand in our travel model. This follows an overhaul of the representation of supply (referred to as supply development henceforth), which is still in progress[1]. The demand development work will first adapt existing model structures from peer agencies, then calibrate these structures to Bay Area conditions and assess their performance. This first step will result in a modeling system referred to as *Travel Model Two*. Next, we will use information gleaned from the development process to design the next version of the demand models.

This technical paper provides a work plan for creating the data summaries needed to calibrate and validate *Travel Model Two*. This paper builds from project team discussions held at MTC February 26, 2014 and from the *Travel Model Two Development: Calibration and Validation Data Summary Needs* (*Calibration Summaries* henceforth).

[1] Documentation is available here: http://analytics.mtc.ca.gov/foswiki/TravelModelTwo/Development.

2 Tasks

The calibration data summary tasks are as follows:

Task 1: Process and Summarize Household Travel Survey Data

The bulk of the calibration summaries will be derived from the 2012/2013 California Household Travel Survey. The following tasks are needed:

Task 1.1: Database Creation

PB will create relational databases of households, persons, daily activity patterns, tours, stops, and trips for Bay Area households. The code to do the processing will be in either Java or Python. PB will apply fuzzy logic rules to identify primary travel (tour and stop) purpose, intermediate stops, link trips into tours, code travel mode (tour and trip), and otherwise prepare the data for use in model calibration.

Prior to performing this work, PB will review and, where advantageous, build from, the work performed on this front by MTC and captured in a blog on the MTC Wiki.

Deliverable(s):

➔ 1.1.1 Household Travel Survey Database

Task 1.2: Expansion Factor Analysis

PB will review the expansion summaries prepared by MTC and available here on the MTC Wiki. As needed, PB will perform additional comparisons of the MTC-prepared household expansion factors at a regional and PUMA level. PB will also compare the expanded results to input land use data provided by ABAG at a county level to assess consistency across household, worker, and employment estimates.

Deliverable(s):

➔ 1.2.1 Spreadsheets and Maps comparing Weighted Survey, Census, and ABAG Estimates

Task 1.3 GPS Analysis

The household travel survey contains GPS traces for about a third of the participating households. PB will examine the GPS data and assess the level of effort needed to extract the data necessary to inform needed adjustments to calibration targets. If the level of effort is acceptable, PB will fully analyze the GPS data and fully incorporate calibration adjustments (i.e., plausibly represent under-reported tours and stops) into Round 3 of the calibration and validation effort under a subsequent task order.

Deliverable(s):

- ➔ 1.3.1 Technical Memorandum Outlining Level-of-Effort Needed to Fully Incorporate GPS Adjustments

Task 1.4: Quality Assurance and Quality Control Data Consistency Checks

MTC will perform an in-depth review of the Household Travel Survey Database (Deliverable 1.1.1) and notify PB if errors are found or suspected. PB will address MTC's concerns and update the database accordingly.

Deliverable(s):

- ➔ 1.4.1 Updated Household Travel Survey Database

Task 1.5: Geo-coding

MTC will provide geo-coding services by identifying the micro-analysis zone (MAZ) and the travel analysis zone (TAZ) for each relevant activity location in the household travel survey database. MTC will also geo-code transit boarding and alighting locations to the nearest, relevant (i.e. on the traveled provider) transit access point (TAP).

Task 2: On-Board Survey Data

The following tasks are needed to prepare the on-board transit data for model development activities.

Task 2.1: Geo-coding

MTC will provide geo-coding services by identifying the MAZ and TAZ for each relevant activity location in the on-board survey. MTC will also geo-code transit boarding and alighting locations to the nearest, relevant (i.e. on the traveled provider) transit access point (TAP).

Task 2.2: Obtain, Summarize, and Compare On-Board Survey Data

PB will obtain BART station-to-station boarding data, Caltrain station-to-station boarding data, Clipper transfer activity summaries, MTC transit survey data, and transit boarding data from MTC. PB will obtain the 2006 SF Muni and 2008 BART surveys and scale them to 2010 conditions using system-wide boarding data. PB will compare the on-board survey data across operators and against the expanded household travel survey data to determine the appropriate targets for transit travel. PB will create calibration targets for each of the tour and trip mode choice models.

Deliverable(s):

- ➔ 2.2.1 Tour and Trip Mode Choice Calibration Targets in a Spreadsheet
- ➔ 2.2.2 Consolidated On-Board Survey Database

Task 3: Prepare Validation Data

The following data needs to be prepared for model validation purposes.

Task 3.1: Highway Validation Data

PB will obtain PeMS counts, Caltrans counts, and arterial counts from MTC. The PeMS station locations and Caltrans post-miles will be delivered as part of the Supply Development Contract. PB will assess the consistency of the PeMS and Caltrans counts where data is available from both sources. PB will examine a sample of the arterial counts to determine their usefulness. If deemed useful to validation, MTC will locate the arterial counts on the roadway networks.

Deliverable(s):

- ➔ 3.1.1 Database of Highway Counts

Task 3.2: Other Validation Data

PB will obtain FasTrak data from MTC. PB will review the data and develop a method to compare data to the simulation results. PB will obtain relevant 2008-2012 American Community Survey data and summarize the information as described in the *Calibration Summaries* technical paper. PB will obtain the 2006-2010 Census Transportation Planning Package (CTPP) data and summarize worker flows by county. PB will summarize all of these data sources in spreadsheets, comparing each to the household travel survey.

Deliverable(s):

- ➔ 3.2.1 Spreadsheet summaries of ACS, CTPP, and Home-Interview Survey data

Task 4: Prepare Initial Skim Data and Estimate Size Terms

The early calibration rounds need to rely on a plausible representation of network congestion. This task will create such a representation.

Task 4.1: Creation of Initial Skims

PB will develop a trip list disaggregation process to convert *Travel Model One* trip lists into synthetic *Travel Model Two* trip lists. The process will involve applying a size-term-based Monte Carlo selection of *Travel Model Two* TAZs based upon the *Travel Model One* TAZ and the size term for the purpose at the trip origin and destination end of the trip. Trip tables will be derived from the resulting trip lists and be assigned to the *Travel Model Two* roadway network to create an initial set of travel times. This process should also reveal network problems and the level of consistency between the network and the zone system.

On the transit side, MTC will compare skim times with the run times reported in the transit schedules. PB will evaluate the extent to which each set of TAP-to-TAP skims are unique, and make recommendations regarding revisions to path-building parameters and/or number of unique skim sets to be used it *Travel Model Two*.

Deliverable(s):

- ➔ 4.1.1 Initial Year 2010 Trip Tables
- ➔ 4.1.2 Initial Year 2010 Loaded Networks

- ➔ 4.1.3 Initial Year 2010 Highway and Transit Skim Tables
- ➔ 4.1.4 Technical Memorandum: Analysis of Transit Skim Sets and Recommendation

Task 4.2: Estimate Destination Choice Size Terms

PB will regress trip attractions by purpose against employment and\or other relevant attraction covariates to create destination choice size terms.

Deliverable(s)

- ➔ 4.2.1 Spreadsheet Summarizing Size Terms
- ➔ 4.2.2 Estimation Dataset and Results

Task 5: Round One Model Calibration, Validation, and Sensitivity Testing

Travel Model Two will be calibrated in several rounds. Each round of calibration will include adjustment of model parameters and/or constants to match observed data; comparison of model outputs to independent estimates of travel (model validation); and a set of sensitivity tests to determine whether the model displays appropriate sensitivities to model inputs. The results and experience gained from the current round of calibration will inform the next round of calibration, and so on until the models fit observed data as well or better than *Travel Model One*.

Task 5.1: Round One Calibration and Validation

PB will perform the first round of calibration and validation. The calibration targets will be approximately met with a broader goal of determining the goodness-of-fit of the model system as a whole. Certain model components, such as tour generation models, can be calibrated to closely match observed targets since such models are fairly easily calibrated, while others will be held to looser standards.

The outcome of this phase will be a prioritized list of calibration activities to focus on for the second round of calibration.

Deliverable(s):

- ➔ 5.1.1 Round One Estimated versus Observed Calibration Spreadsheets
- ➔ 5.1.2 Round One Utility Expression Calculator (UEC) Spreadsheets
- ➔ 5.1.3 Round One Calibration Slide Deck
- ➔ 5.1.4 Technical Memorandum: Calibration Data Assembly, Results, and Recommendations for Round Two

Task 5.2: Round One Sensitivity Tests

PB will propose and carry out a set of sensitivity tests to assess the model system's elasticities and reveal software or coding errors. At least three sensitivity tests will be carried out; potential tests include:

- Response to varying toll rates on a managed roadway lane or facility;
- Response to the introduction of a major new fixed guideway route; and\or
- Response to the introduction of a large employment center or mixed-use development.

PB will evaluate the results of the tests and make appropriate changes and\or bug fixes to the model parameters, Cube scripts, and\or application code.

Deliverable(s):

➔ 5.2.1 Round One Sensitivity Test Data Summary Spreadsheets
➔ 5.2.2 Technical Memorandum Documenting Round One Sensitivity Test Procedures, Results, and Recommendations

Task 6: Round Two Model Calibration, Validation, and Sensitivity Testing

The next round of calibration will build from and improve upon Round One.

Task 6.1: Round Two Calibration and Validation

PB will perform the second round of calibration and validation. Round Two will tighten the criteria for matching observed data and focus on more-difficult-to-calibrate components, such as destination and mode choice, by more closely examining transit trips by line-haul mode and district-to-district flows. Increased scrutiny will be placed on the validation criteria. For example, PB will examine highway screenline estimates, transit boardings, and transit transfer rates.

The outcome of this phase will be a prioritized list of calibration activities to focus on for the third round of calibration.

Deliverable(s):

- ➔ 6.1.1 Round Two Estimated versus Observed Calibration Spreadsheets
- ➔ 6.1.2 Round Two Utility Expression Calculator (UEC) Spreadsheets
- ➔ 6.1.3 Round Two Calibration Slide Deck
- ➔ 6.1.4 Technical Memorandum: Calibration Data Assembly, Results, and Recommendations for Round Three

Task 6.2: Round Two Sensitivity Tests

PB will re-run the sensitivity tests (determined in Task 5.2) and re-evaluate the results of each test. PB will evaluate the results of the tests and make appropriate changes and\or bug fixes to the model parameters, Cube scripts, and\or application code.

Deliverable(s):

- ➔ 6.2.1 Round Two Sensitivity Test Data Summary Spreadsheets
- ➔ 6.2.2 Technical Memorandum Documenting Round Two Sensitivity Test Procedures, Results, and Recommendations

Task 7: On-Board Survey Data Assignment and Analysis

The availability of large-scale on-board survey data for multiple operators in the Bay Area provides a unique opportunity to verify the accuracy of the transit network provided under the current Supply Development Contract. Further, the data facilitates the development of path-finding and utility calculation parameters.

Task 7.1: On-Board Survey Data Assignment and Analysis

PB will assign each on-board survey record to its boarding and alighting TAP pair. The simulated route itinerary and transfer locations can then be compared to the reported route itinerary and transfer locations to determine the efficacy of the path building parameters. Records that are not assigned to their reported route will be further investigated to determine the cause of error.

In the second phase of the work, path parameters will be formally estimated by estimating a choice model using all available TAP-to-TAP movements as the choice set. Coefficients can be estimated on out-of-vehicle time, in-vehicle time, fare, transfers, and other parameters relevant to path.

Deliverable(s):

- 7.1.1 Technical Memorandum Documenting On-Board Survey Assignment Results
- 7.1.2 Spreadsheet Summarizing On-Board Survey Assignment Results
- 7.1.3 On-Board Survey TAP-to-TAP Trip Tables
- 7.1.4 Technical Memorandum Documenting On-Board Survey Path Estimation Results
- 7.1.5 Spreadsheet Documenting Estimation Results
- 7.1.6 On-Board Survey Path Estimation Files

3 Schedule

The project schedule is shown in Figure 1.

Figure 1: Task Schedule (Apr 2014 to Mar 2015)

Task		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1	Process and Summarize Household Travel Survey												
1.1	Database Creation												
1.2	Expansion Factor Analysis												
1.3	GPS Analysis												
1.4	QA\QC Data Consistency Checks												
1.5	Geo-coding												
2	On-board Survey Data												
2.1	Geo-coding												
2.2	Obtain, Summarize, and Compare On-Board Survey Data												
3	Prepare Validation Data												
3.1	Highway Validation Data												
3.2	Other Validation Data												
4	Prepare Initial Skim Data												
4.1	Creation of Initial Skims												
4.2	Estimate Destination Choice Size Terms												
5	Round One Calibration, Validation, and Sensitivity Testing												
5.1	Calibration and Validation												
5.2	Sensitivity Testing												
6	Round Two Calibration, Validation, and Sensitivity Testing												
6.1	Calibration and Validation												
6.2	Sensitivity Testing												
7	On-Board Survey Data Assignment and Analysis												
7.1	On-Board Survey Data Assignment and Analysis												

PB lead; MTC lead

fin.